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SENSORY EFFECT AND BIOACCESSIBILITY OF MICROENCAPSULATED IRON-FORTIFIED CASSAVA FLOUR AND FLAKE

Hoerudin[1*], Juniawati[1], Sri Yuliani[1], Widaningrum[1],
Dewi Utari Wulandari[2], Endang Prangdimurti[2] and Olivier Gibert[1,3]

[1]Indonesian Center for Agricultural Postharvest Research and Development, Indonesian Agency for Agricultural Research and Development, Jl. Tentara Pelajar No. 12, Bogor 16114, Indonesia
[2]Department of Food Science and Technology, Bogor Agricultural University, Jl. Raya Darmaga Kampus IPB Darmaga, Bogor 16680, Indonesia
[3]CIRAD, Joint Research Unit QUALISUD, 34398 Montpellier Cedex 5, France

INTRODUCTION

- Cassava is one of current and future alternative staple foods in Indonesia. However, cassava lacks micronutrients, e.g. iron. Iron deficiency remains a nutritional problem in Indonesia.
- Fortification of food is a common strategy for fighting against iron deficiency worldwide, including in Indonesia. However, the use of free iron as a fortificant may induce some undesirable effects, such as potential interaction with other beneficial food components, some food darkening, and metal taste in the final food products. Microencapsulation technique may solve the problems by protecting iron from environmental conditions.
- The objectives of this study were then to investigate the sensory effect and bioaccessibility of microencapsulated iron-fortified cassava flour and flakes in comparison to the supply of free iron.

MATERIALS AND METHODS

- Iron ($FeSO_4.7H_2O$) was microencapsulated with a combination of maltodextrin and whey (60:40) using a spray drying technique.

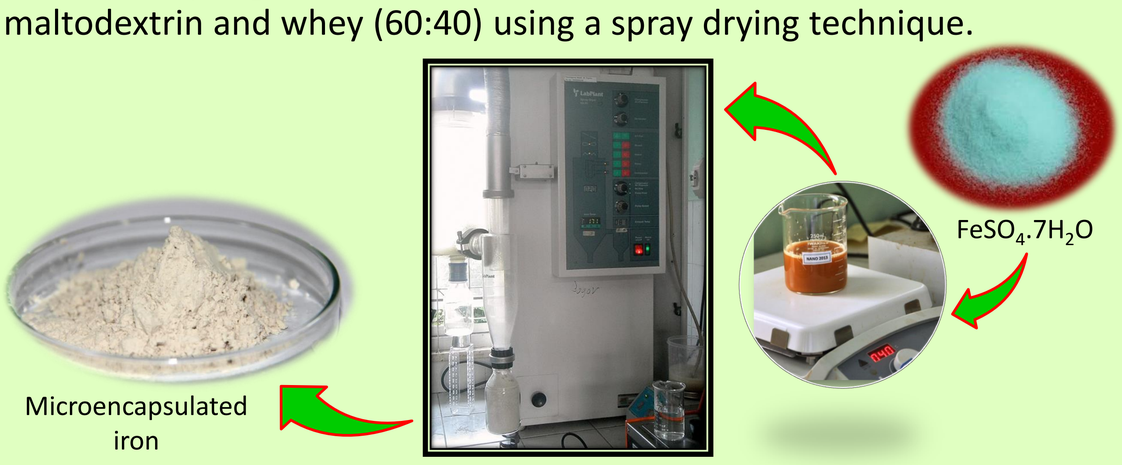

Figure 1. Microencapsulation of iron

- Cassava flesh of Adira 1 variety was mechanically chipped, dried (60°C), milled and sieved (100 mesh). Cassava flour was fortified with $FeSO_4.7H_2O$ and microencapsulated iron. The fortified flour was pre-cooked with egg yolk, leaven, maltodextrin, sugar, salt, and cocoa powder and then molded and baked.

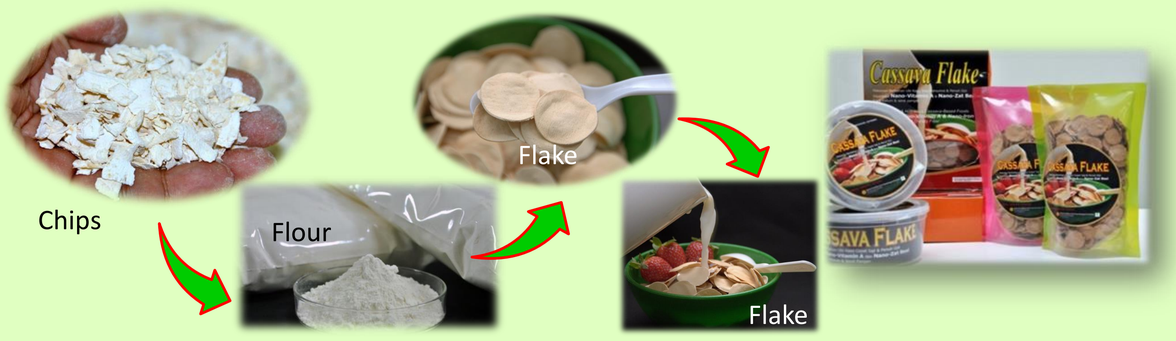

Figure 2. Processing of cassava flake

- Sensory evaluation involved 71 untrained panelists. An *in vitro* digestion experiment mimicking human gastrointestinal tract conditions (Cagnasso et al. 2013; Cilla et al. 2009) was conducted to determine iron bioaccessibility. Iron concentration was determined by AAS.

RESULTS

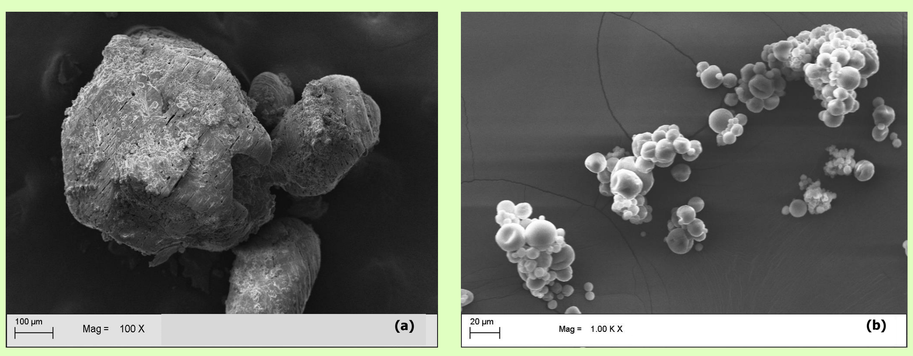

Figure 3. SEM images of (a) $FeSO_4.7H_2O$ and (b) microencapsulated iron particles

RESULTS *(continued)*

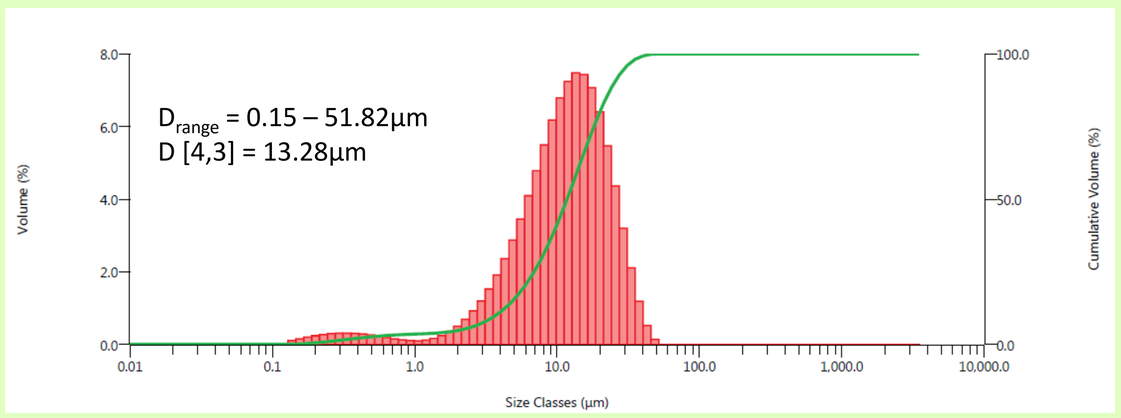

Figure 4. Particle size distribution of microencapsulated iron

- Particle sizes and moisture content (3-5%) of microencapsulated iron met general characteristics of spray dried microcapsules (Sampath et al. 2013).

Table 1. Characteristics of cassava flour before and after fortification

Characteristics	Without fortification	$FeSO_4H_2O$ fortification	Microencapsulated iron fortification
Moisture (%)	8.83 ± 0.61	11.0 ± 0.56	8.82 ± 0.24
Color (L)	100.62 ± 0.29	100.60 ± 0.44	100.69 ± 0.37
Whiteness index	87.42 ± 0.24	87.26 ± 0.31	87.39 ± 0.27
Iron (ppm)	9.17 ± 0.90	18.88 ± 0.85	19.15 ± 0.77
Iron recovery (%)	-	97.44 ± 4.40	98.82 ± 4.00

Numbers are expressed as mean ± SD (n ≥ 3)

Table 2. Characteristics of cassava flake before and after fortification

Characteristics	Without fortification	$FeSO_4H_2O$ - fortification	Microencapsulated iron-fortification
Moisture (%)	2.28 ± 0.24	2.04 ± 0.08	2.13 ± 0.15
Color (L)	68.23 ± 2.36	61.80 ± 1.64	67.36 ± 1.48
Hardness (g)	594.17 ± 28.22	440.50 ± 4.01	417.25 ± 12.61
Iron Bioaccess (%)	25.70 ± 2.61	34.40 ± 0.50	49.65 ± 1.50

Numbers are expressed as mean ± SD (n ≥ 2)

- Fortification of microencapsulated iron increased iron content, without influencing moisture content, color, and whiteness index of the original cassava flour. Cassava flakes fortified with microencapsulated iron was softer than those fortified with free iron or without fortification.
- Bioaccessibility of iron from cassava flakes fortified with microencapsulated iron was higher than that of fortified with free iron or without fortification. Cassava flakes fortified with microencapsulated iron was preferred by untrained panelists.

CONCLUSION

- The results imply that the microencapsulation technique could reduce potential interaction of iron with other food components, reduce its exposure to environment, and hence improve its bioaccessibility with acceptable sensory characteristics, which in turn, may enhance its bioavailability and thus efficiency.

REFERENCES

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*Corresponding author: hoerudin@litbang.pertanian.go.id

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